

FORMATION OF TERNARY GRAPHITE INTERCALATION COMPOUNDS WITH CuCl_2 AND H_2SO_4

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Introduction

A great amount of attention is given to synthesis of ternary graphite intercalation compounds (TGIC). A strict consecution of two intercalates in graphite matrix is typical for such compounds. The purpose of this work was to investigate the possibility of sulfuric acid to intercalate into acceptor GIC. Graphite intercalation compound with CuCl_2 was chosen as the acceptor GIC thanks to its high stability.

Results and discussion

To carry out synthesis in the graphite – CuCl_2 system permit to obtain GIC at different stages. GIC – CuCl_2 at I stage is highly stable and replacement of copper chloride by sulfuric acid does not occur. II stage gives the only one opportunity of ternary GIC formation. Thus, III stage of GIC – CuCl_2 was chosen because of allowing varying composition and structure of TGIC with CuCl_2 and H_2SO_4 .

Single-phase samples of III stage GIC with composition $\text{C}_{14.7}\text{CuCl}_2$ were used to synthesize ternary GIC. Intercalation of sulfuric acid into GIC – CuCl_2 was carried out in the presence of oxidizer. Variety of products can be obtained depending on the time of treatment: either "sesquialteral" GIC, the structure of which can be formed by alternately interchangeable layers intercalated with CuCl_2 , H_2SO_4 and empty layer, or (in case of long treatment) "sandwich"-structured GIC, consists of two layers intercalated with H_2SO_4 and one – with CuCl_2 . Period of identity (I_c) is 21.10 Å for "sesquialteral" GIC and 25.50 Å for "sandwich" – structured one.

Hydrolysis of ternary GIC – CuCl_2 – H_2SO_4 leads to unusual compound with initial structure of

GIC – CuCl_2 , but the layers of sulfuric acid are absent.

Further thermal treatment of samples under mild condition (600 °C) allows obtaining unique material, expanded among "c" – axis, still contains CuCl_2 (exfoliated-GIC). Increasing of temperature up to 800 – 900 °C is the reason promote to decomposition of GIC with CuCl_2 and obtaining ordinary exfoliated graphite, based on expandable graphite.

Exfoliated – GIC posses not only low bulb density but also high electrical conductivity. Increasing of conductivity is caused by the presence of GIC with CuCl_2 , where redistribution of π – electronic density of carbon among intercalated molecules is occurred and results appearance of extra holes in the graphite layers.

Conclusions

The synthesis of ternary and exfoliated GIC can be illustrated by the following scheme:

